Cystotomy

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Cystotomy is a common surgical procedure in small animal surgery, most often performed for removal of cystoliths. Other indications include biopsy, urethral catheterization and surgical correction of ectopic ureters. When treating urethral obstruction, retropulsion of the urethral stones into the urinary bladder is required, ideally prior to taking the patient to surgery.

Radioopaque stones are visible radiographically, this is typically the case for oxalate stones and calcium phosphate stones and radiolucent stones such as ammonium biurate and cystine are not typically radiographically visible and are typically identified ultrasonographically or with the use of contrast. Radiographs are recommended to assess the location, size and approximate number of calculi prior to surgery.

Catheterization is recommended prior to positioning the patient in dorsal recumbency to prevent cystic calculi moving into the proximal urethra. When stones are present within the urethra, they should be retropulsed into the urinary bladder prior to moving to surgery. Note that urethral stones are not always associated with signs of obstruction. Retropulsion is performed under heavy sedation or under general anesthesia. Fill 2 to 3 - 20cc syringes with sterile saline mixed with water-soluble lubricant. Pass the largest urinary catheter that can be accommodated within the urethra sterily to the level of the obstruction without forcing it. Infuse a small quantity (1-3ml) of lidocaine solution (ensure you consider the toxic dose in small patients) into the catheter followed by enough sterile saline to ensure it is delivered to the site of obstruction. This will help relax local urethrospasm. Then ask an assistant to pass a gloved finger into the rectum to temporarily obstruct the proximal urethra with digital pressure. Using the pre-filled syringes, pulse saline relatively forcefully while attempting to advance the catheter. The tip of the penis may need to be occluded using gauze and the tips of the index finger and thumb to prevent saline from flowing distally.
The assistant should remove the digital urethral pressure at once when sufficient urethral distention is palpable allowing the stones to pass back into the urinary bladder. Repeat as needed. Always assess bladder size by gentle palpation prior to performing retropulsion to prevent over-distending the bladder risking rupture. Repeat a lateral (+/- VD) radiographic view to ensure all the stones have returned to the bladder prior to surgery. Leave the urinary catheter in place to prevent stones moving into the urethra.

In preparation for surgery, the area from the xiphoid to the pubis should be clipped and prepped, including the prepuce in males. The prepuce should be flushed with antiseptic solution. Cystotomy is performed through a standard caudal midline laparotomy approach. The urinary bladder is identified, exteriorized and isolated from the remainder of the abdominal cavity using sterile, saline soaked laparotomy sponges in order to perform a ventral midline cystotomy. Dorsal cystotomy is not recommended since it has no advantages over a ventral cystotomy when it comes to postoperative leakage or recurrent stone formation. A dorsal cystotomy incision locates the cystotomy incision closer to the ureteral papillae increasing the risk of inadvertent damage or inclusion within the closure. It also leads to ‘kinking’ of the urinary bladder neck making stone retrieval difficult.

Stay sutures are placed on midline at the apex and neck of the bladder to reduce urine leakage into the abdomen, facilitate the procedure and reduce tissue handling. The ventral ligament of the bladder connects the bladder to the linea alba (and once contained the urachus) and may need to be incised to expose the ventral midline. The surgeon should confirm the location of the lateral ligaments / ureters when planning the incision. After emptying the bladder (if necessary), a stab incision is made in a relatively avascular region of the urinary bladder along the midline and extended using Metzemaum scissors. The incision should be caudal enough to allow direct visualization of the trigone but without entering the urethra. If urine was not previously cultured or was negative on a preoperative cystocentesis, a sample of bladder mucosa should be collected for bacterial culture and can be combined with crushed urinary calculi for submission. There was no difference in culture results (positivity and bacterial type) when antimicrobials were given at anesthetic induction versus after surgical culture sample collection for dogs undergoing cystotomy for cystic calculi removal such that withholding antibiotic therapy until culture is not
recommended. A full thickness bladder wall sample can be collected for histopathology if deemed appropriate.

Using a combination of suction, forceps, bladder spoons or curettes, the urinary bladder is gently cleaned of all visible calculi. Additional stay sutures can be added along the incision for extra visualization. Once all calculi have been removed, an assistant is asked to flush sterile saline through the urinary catheter as it is slowly pulled out of the bladder neck and urethra (hydroretropulsion). During retropulsion, the surgeon suctions (if available) and collects any remaining urethral calculi that enter the urinary bladder. Flushing should be repeated a few times. Normograde catheterization and flushing (hydropropulsion) is possible but is preferentially performed in females. A urinary catheter is not typically maintained postoperatively. In circumstances where the bladder integrity is poor or a cystectomy was performed, a soft catheter may be maintained (at the level of the trigone) for 1-3 days postoperatively and the bladder omentalized to promote healing. Prior to closure, the bladder mucosa is inspected for evidence of residual calculi and neoplasia and biopsied as necessary. A small endoscope (cystoscope, arthroscope, laparoscope) can be used to assess the proximal urethra for presence of residual calculi.

Closure of the bladder is performed in one or two layers. Single layer (simple continuous appositional) closure is preferred for thick and inflamed bladders due to the friable nature of the bladder wall and inability to invert the tissues. Inverting a thick bladder wall can also overly compromise the size of the bladder lumen. When possible, the author prefers to perform a two-layer closure. The first layer is closed in a simple continuous appositional pattern ensuring that the bladder is stretched (use the previously placed stay sutures) to prevent placing the sutures too far apart and in order to create a watertight seal. The second layer consists of either a Cushing or Lembert (partial thickness) inverting pattern to oversew the first layer. During the oversew, ensure that bites are taken close to the incision line and that these don’t include the ureter / lateral ligament of the bladder. The appositional single-layer suture pattern for cystotomy closure did not result in increased complication while there was no clear advantage to the use of the inverting double-layer suture pattern in a recent study.
Bladder closure should be achieved with the smallest suture material possible; typically 3-0 or 4-0. Full thickness bites are typically recommended as they ensure purchase of the submucosa, which is essential to obtain a safe closure. Avoiding the mucosa has been recommended in order to reduce the risk of suture nidus for future calculi formation, but is often difficult to achieve. The author does not attempt to avoid the bladder mucosa during closure.

Synthetic, absorbable, monofilament suture material is recommended for urinary surgery. Since the normal bladder regains 100% of its tensile strength within 14-21 days, rapidly absorbable suture materials could theoretically be used for bladder wall closure. However, bacterial infection resulting in alkaline urine (e.g. *Proteus* sp.) has been associated with early loss of suture tensile strength making such suture possibly inadequate for closure. Non-absorbable and braided suture are thought to harbor bacteria and debris possibly serving as a urolith nidus. Similarly, sutures such as PDS and Maxon that take much longer to dissolve have been proposed to possibly increase the risk of suture associated nidus for future stone formation prior to their dissolution.

In contrast to the recommendation to avoid braided suture to prevent suture nidus for stone formation, a study of cystotomy practices in Ontario revealed the lowest rate of postoperative urinary tract infection with the use of Vicryl suture compared to monocryl and PDS. The rapid rate of suture dissolution was theorized as the possible mode by which this occurred. Further studies are required in order to make firm recommendations for type of suture to be used for urinary bladder closure.

The urinary calculi should be submitted for analysis to ensure appropriate preventative measures are taken to prevent stone recurrence. Postoperative radiographs are taken immediately postoperatively (while under anesthesia) to ensure all radiopaque calculi have been removed. Removal of all radiolucent calculi is confirmed using positive contrast urethrocystogram. Should calculi remain in the bladder or the urethra postoperatively, the recommendation is to return to surgery immediately (after repeat hydroretropulsion if urethral calculi are identified) for their removal.
Postoperatively, patients are continued on intravenous fluids overnight to encourage flushing of any blood clots. Owners are advised that mild hematuria and pollakiuria may be present for 3-5 days but should resolve quickly. Dietary recommendations are made for prevention once the results of stone analysis are available.

Complications following cystotomy include incisional complications, incomplete removal or recurrence of stones, urinary tract infection, dehiscence and uroabdomen.\(^4\) Laparoscopic-assisted cystotomy and percutaneous cystolithotomy have mostly replaced open cystotomy at the author’s workplace on the basis of being less invasive. Laser lithotripsy is also becoming more commonplace and is completely non invasive (no incision required) but has size and gender restrictions depending on the equipment available.

References


Additional references:
